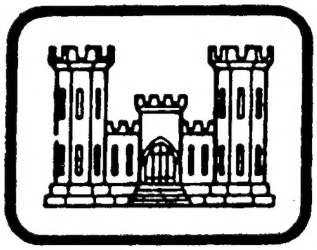
U.S. ARMY HOSPITAL, NUERNBERG

HOSPITAL ENERGY STUDY

FINAL REPORT

EXECUTIVE SUMMARY



United States Army
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Europe Division

APRIL 1987

Stottler Stagg International, Inc.
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Stottler Stagg International
Architects Engineers Planners Inc
Brussels Frankfurt Manila Riyadh

8660 Astronaut Boulevard Cape Canaveral Florida 32920 (305) 783-1320 Telex: 510-958-2360 SSI CAVL

April 24, 1987

U.S. Army Corps of Engineers
Europe Division
ATTN: EUDED-ST, Mr. Dale N. Bickenbach, Project Manager
APO New York 09757

Ref: Contract No. DACA90-85-C-0118, Energy Engineering Analysis Program (EEAP), Nuernberg Army Hospital

Subj: Transmittal of the Final Report Executive Summary

Gentlemen:

The attached Executive Summary is transmitted in accordance with the reference.

Sincerely,

Edwin J. Smith, P.E.
Project Manager

EJS:smp.85360

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HOSPITAL ENERGY STUDY

ENERGY ENGINEERING ANALYSIS PROGRAM (EEAP)

U.S. ARMY HOSPITAL, NUERNBERG

Submitted to:

U.S. Army Corps of Engineers
Europe Division, EUDED-SE

Contract No: DACA90-85-C-0118

APRIL 1987

Submitted by:

Stottler Stagg International, Architects, Engineers,
Planners, Inc.
8660 Astronaut Boulevard
Cape Canaveral, Florida 32920

E.1.0 EXECUTIVE SUMMARY

E.1.1 INTRODUCTION:

This Executive Summary presents condensed information for the Nuernberg Army Hospital Energy Study in the format specified by Annex C to the Statement of Services.

The Nuernberg Army Hospital is located in Nuernberg, Germany, at a small installation which is entirely related to the Hospital. The Hospital, itself, is a complex facility totalling 532,062 square feet and consisting of a combination of remodeled older structures and more recently constructed facilities.

The EEAP for the U.S. Army Hospital, Nuernberg, (USAHN) was initiated with field investigation work in February 1986. The Interim Report was submitted in May 1986 with revisions in June 1986. The Interim Report Presentation and Review Conference was in July 1986, at which time some added field investigation was undertaken.

This Executive Summary is being submitted with the Prefinal Report.

E.1.2 PRESENT ENERGY CONSUMPTION:

Fiscal Year 1985 consumption of energy for the Hospital was derived from DEH Records of energy purchases for GY 342, the installation's identification number.

E.1.2.1 TOTAL ANNUAL ENERGY:

The total annual energy used by the Hospital in FY 85 was:

TOTAL ENERGY	MBTU/YEAR
Electricity (site)	16,969
Solid Fuel (Coal)	29,132

Natural Gas		22,227
No. 2 Fuel Oil		15,140
	Total	83,468

E.1.2.2 SOURCE ENERGY CONSUMPTION AND COST:

The costs per Million British Thermal Units (MBTU's) in dollars, used in this report were:

Electricity	$14.06
Natural Gas	$ 5.57
Fuel Oil	$ 6.32
Coal	$ 5.26

The purchase units and costs of energy for FY 85 are shown below. With the exception of coal, energy purchases are paid for in Deutsch Marks (DM). Conversion to dollars is based on 3.0 DM/$, an EUD-provided factor used throughout the report. (Since the provision of guidance to use DM 3.0/$, the value of the dollar has decreased in relation to the DM.)

TYPE ENERGY	UNITS	DM/UNIT	TOTAL DM	EQUIV $
Electricity	4,971,853 KWH	0.1441	716,444	238,815
Natural Gas	582,521 Cu.M	0.638	371,648	123,883
Fuel Oil	109,872 Gal	*2.613	287,096	95,699

* From VII Corps $6.32/MBTU times 0.1378 MBTU/Gallon times 3.0 DM

In FY 85, all solid fuel purchases were Anthracite Coal. Actual costs consist of dollars per metric ton for purchase and DM per metric ton for local delivery. The VII Corps price in dollars is used to assure inclusion of other delivery and handling charges. Thus, coal cost is:

M. TONS	BASE $/T	TOTAL $
993.35	**154.26	153,234

** From VII Corps $5.26/MBTU times 29.3265 MBTU/M.Ton

Total FY 85 dollars equivalent energy cost for the Hospital was $611,631.

E.1.2.3 BREAKOUT OF ENERGY CONSUMPTION:

Monthly energy consumption for FY 85 is presented in Table ES-1. Electricity and natural gas figures represent actual monthly consumption. Coal and oil figures represent deliveries and, since inventory data is not maintained, can only approximate consumption.

TABLE ES 1

FY '85 MONTHLY ENERGY CONSUMPTION, MBTU'S

	84 OCT	NOV	DEC	85 JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEPT
ELECIRICTTY	1,314	1,312	1,479	1,243	1,221	1,109	1,395	1,632	1,520	1,555	1,524	1,664
SOLID FUEL*	2,731	3,769	4,028	4,735	5,266	4,208	2,160	-0-	319	-0-	70	1,845
NATURAL GAS	1,359	2,142	1,812	2,806	1,590	532	2,056	3,790	2,392	1,793	1,518	435
FUEL OIL*	1,092	1,311	1,201	1,092	2,293	1,201	1,201	109	1,201	1,201	1,198	2,039
TOTAL	6,496	8,534	8,520	9,876	10,370	7,050	6,812	5,531	5,432	4,549	4,310	5,983

* DELIVERIES

E.1.3 HISTORIC ENERGY CONSUMPTION:

E.1.3.1 DEFINITION:

Prior to FY 82, the physical configuration of the USAHN was smaller. The remodeling and expansion of USAHN was completed late in FY 81 and energy expenditures for an added 136,385 sq. ft. of heated and cooled space were initiated.

For USAHN, then, "historic" energy consumption consists of FY's 82, 83, and 84.

E.1.3.2 ENERGY CONSUMPTION DATA:

The average energy consumption for the three FY's was 84,352 MBTU. Using the average as an index of 1.0., the variances for the 3 years range from -9 to +5% of average.

Table ES-2 presents the annual total MBTU's for the three FY's. The average consumption and variances for each fuel are also provided. The reasons for variations in consumption of heating fuel uses from year to year are not known. As is seen in the supplementary line for total heating fuels, the variation of the total from average, -11 to +6, is smaller than the variation of the individual heating fuels. Since the new dual fuel heating plant (464A) can serve as backup for the coal plant, it is assumed that the most significant variations which occurred in FY 83, where solid fuel consumption was lower than "normal" and natural gas was higher, result from operational factors.

TABLE ES-2

ANNUAL ENERGY CONSUMPTION, MBTUS

Type of Energy	FY 82	FY 83	FY 84	Average	% Variance
Electricity	15,404	17,428	16,553	16,462	± 6
Natural Gas	20,722	37,265	16,901	24,963	-32, +49
Fuel Oil	19,796	14,218	13,326	15,780	-16, +25
Solid Fuels*	31,172	19,927	30,344	27,148	-27, +15
Total Energy	87,094	88,838	77,124	84,352	- 9, + 5
Total Heating Fuels	71,690	71,410	60,571	67,890	-11, + 6

*Data for Coke and Anthracite Coal is combined. Purchases of Coke ended in April 1984.

E.1.4 ENERGY CONSERVATION ANALYSIS

E.1.4.1 ECO'S INVESTIGATED:

The SOS requires review of ECO's specified in Annexes A-1 and A-2 and should integrate the results of the prior studies/work in progress.

Table ES-3 lists the ECO's identified as applicable to the Hospital in the Energy Engineering Analysis Program (EEAP) for the Nuernberg Military Community (MILCOM), a prior study.

The column, "Incorporated by DEH" notes those items which were reported by the DEH as having been done since the MILCOM EEAP.

TABLE ES - 3

ECO'S FROM THE EEAP FOR NUERNBERG MILCOM (PRIOR STUDY)

DESCRIPTION	RECOMMENDED	INCORP'D BY DEH	PLANNED OR IN-PROCESS	NOT RECOMMEDED	RESTUDIED HEREIN AS
Install thermostatic radiator valves	X		TNB 4189, FY '87		HVAC-22
Thermopane Windows				X	BLDG-2
Door Weatherstripping	X	X			BLDG-1
Ceiling Insulation	X	X			BLDG-3
Reduce outside air				X	HVAC-2
District Heating, Including GY410	X		TNB 4197, FY '89 +		USAREUR-4
DHW Recirculation				X	PL-1
Convert 3-way valves to 2-way	X				HVAC-10
Calibrate boiler & heating controls	X				MAINT PROCED.
Insulate valves and fittings	X		WO 19185		
Night setback, heating, theatre	X		Part of WO 19685		HVAC-26
Preheat DHW makeup water using heat Heat Recovery from Cooling Tower	X				HVAC-34
Revise exterior lighting	X		TNB 4201, FY '89 +		
Replace 40 watt lamps w/34 watt	X	X			
Photocell lighting control				X	L-1

DESCRIPTION	RECOMMENDED	INCORP'D BY DEH	PLANNED OR IN-PROCESS	NOT RECOMMEDED	RESTUDIED HEREIN AS
Motion sensor lighting controls	X				L-1
Peak shaving using emergency gen'rs	X				ELEC-4
Delamping	X	X			
EMCS	X		WO20086		MISC-2
Insulate heat system piping	X	X			

Table ES-4 lists the ECO's evaluated in this study. A discussion of each ECO is provided in Volume I, Section 5 of the Report. The Index of Section 5 is referenced to the ECO number and name used in Table ES-4.

TABLE ES - 4

SUMMARY OF STATUS FOR ALL ECO'S

NUMBER	DESCRIPTION	FEASIBLE	NOT FEAS	N/A	IMPLEMENTATION
HVAC-1	Shut off air handling units whenever possible.	X			EMCS
HVAC-2 incl HVAC-17	Reduce outside air intake when air must be heated or cooled before use - Use outside air for free cooling wherever possible.	X			EMCS
HVAC-3	Reduce volume of air circulated through air handling units.			X	ETL-1110-3-344
HVAC-4	Shut off or reduce speed of room fan coils.			X	No fan coils
HVAC-5	Shut off or reduce stairwell heating.	X			T-stat valves, TNB 4189
HVAC-6	Shut off unneeded circulation pumps (for space heating).		X		Mixed use areas
HVAC-7	Reduce humidification to minimum requirements.			X	Specified
HVAC-8 INCL HVAC-15	Reduce condenser water temperature - Raise chilled water temperature.			X	Auto coontrol
HVAC-9	Cycle fans and pumps.			X	HVAC-1 better
HVAC-10	Reduce pumping flow (convert 3-way valves to 2-way).	X			HVAC-10

NUMBER	DESCRIPTION	FEASIBLE	NOT FEAS	N/A	IMPLEMENTATION
HVAC-11	Reset thermostats higher during cooling and lower during heating:				
	- Radiation heated zones			X	T-stat valves
	- Theatre and chapel	X			HVAC-35 & 36 + EMCS
	- Air Conditioned zones	X			EMCS
HVAC-12	Repair and maintain steam lines and traps.	X			In-process P.M.
HVAC-13	Use damper controls to shut off air to unoccupied areas.			X	No such areas
HVAC-14	Reset hot and cold deck temperatures based on areas with greatest need.	X			EMCS
HVAC-16	Shed loads during peak electrical use periods.		X		See text
HVAC-18 INCL HVAC-25	Reduce reheating of cooled air. Eliminate simultaneous heating and cooling.	X			EMCS & Calibration
HVAC-19	Recover heating or cooling with energy recovery units.	X			HVAC-19
HVAC-20	Reduce chilled water circulated during light loads.			X	Is automatic
HVAC-21	Install minimum-sized motor to meet loads.			X	Maintenance As Req'd
HVAC-22	Replace hand valves with automatic controls.			X	TNB 4189
HVAC-23	Install variable air volume controls.			X	Existing As Req'd
HVAC-24	Insulate ducts and piping:				
	- Hot water piping - HVAC ducting			X	Existing
	- Valves and fittings, heat piping			X	WO 19185

NUMBER	DESCRIPTION	FEASIBLE	NOT FEAS	N/A	IMPLEMENTATION
HVAC-26	Install night setback controls.	X			EMCS
HVAC-27 INCL HVAC-28	Clean coils. Maintain filters.			X	Normal Maint
HVAC-29	Repair and/or maintain air handling controls.	X			EMCS and Maintenance as Req'd
HVAC-30	Multi-speed/variable speed cooling tower fans.			X	Damper controls installed
HVAC-31	Use centrifugal chillers instead of absorption chillers.			X	Centrif. now
HVAC-32	Heat reclaim for Walk-In coolers.		X		Low SIR
HVAC-33	Chiller-condenser tube cleaning.	X			HVAC-33
HVAC-34	Heat reclaim, Chiller/Condenser system.	X			HVAC-34
HVAC-35	Replace HVAC System, Theatre	X			HVAC-35
HVAC-36	Replace HVAC System, Chapel	X			HVAC-36
BLR-1	Reduce steam distribution pressure.			X	PRV's exist
BLR-2	Shut off steam to laundry when not in use.			X	No laundry
BLR-3	Increase boiler efficiency. Oil-fired boilers	X			BLR-3
BLR-4	Repair, replace, or install condensate return system.			X	Good cond'n.

NUMBER	DESCRIPTION	FEASIBLE	NOT FEAS	N/A	IMPLEMENTATION
BLR-5	Insulate boilers and piping. Dual-fuel and oil-fired			X	Insulated
	Coal-fired			X	Stand by
BLR-6	Install economizer.	X			Gas boilers
BLR-7	Install air preheater.	X w/Misc-1			Gas boilers, conditional
BLR-8	Check boiler water chemistry program.			X	Installed
BLR-9	Clean boiler tubes.			X	H_2O treated
BLR-10	Blowdown controls.			X	Exist
BLR-11	Boiler and chiller control modification.			X	Exist
BLR-12	Common manifolding of chillers.			X	Exists
BLR-13	Water treatment to prevent fouling.			X	Exists
L-1	Shut off lights when not needed.	X			Auto controls rejected by USAHN
L-2	Reduce lighting levels.			X	Delamped
L-3	Revise cleaning schedules.			X	Maint. OK
L-4	Convert to energy efficient system.			X	TNB-4201
BLDG-1	Reduce infiltration by caulking and weatherstripping.			X	New doors & wdws.

NUMBER	DESCRIPTION	FEASIBLE	NOT FEAS	N/A	IMPLEMENTATION
BLDG-2	Install storm windows or double pane windows.		X		Low SIR
BLDG-3	Install roof insulation.	X			BLDG-3
BLDG-4	Install loading dock seals.			X	See text
BLDG-5	Install vestibules on entrances.			X	Main OK
BLDG-6	Reduce window's heat gain by solar shading, screening, curtains or blinds.			X	See text
BLDG-7	Install wall insulation.		X		See text, BLDG-7
ELEC-1	Shut off elevators whenever possible.	X			EMCS
ELEC-2	Shut off pneumatic tube system whenever possible.			X	No system
ELEC-3	Install capacitors or synchronous motors to increase power factor.			X	Installed
ELEC-4	Use emergency generator to reduce peak demand.		X		See text
ELEC-5	Shed or cycle electrical loads to reduce peak demand.		X		See text
ELEC-6 incl ELEC-7	Balance loads. Reduce transformer losses by proper loading and balancing.			X	Balance OK
ELEC-8	Convert to energy efficient motors.	X			Maint.
PL-1	Reduce domestic hot water temperature.			X	At spec.
PL-1A	Timed recirculation for DHW (new building).	X			PL-1A & 1C

NUMBER	DESCRIPTION	FEASIBLE	NOT FEAS	N/A	IMPLEMENTATION
PL-1B	Recirculation of DHW, old building	X			PL-1B
PL-C	Point of use water heaters, new building	X			PL-1A & 1C
PL-2 incl PL-6	Repair and maintain hot water and steam piping insulation. Add pipe insulation.			X	All OK
PL-3	Install flow restrictors.	X			PL-3
PL-4	Install spring return faucets		X		Low SIR
PL-5	Decentralize water heating.		X		See text
LBRY 1-4	All laundry ECO's.			X	No laundry
KIT-1	Shut off range hood exhaust whenever possible.			X	Discipline OK
KIT-2	Install high-efficiency steam control valves.			X	PRV's in now.
KIT-3	Shut off equipment and appliances whenever possible.			X	Discipline OK
KIT-4	Install makeup air supply for exhaust.			X	Exists
KIT-5	Install heat reclamation for exhaust heat.		X		See text
KIT-6	Turn off lights in coolers.			X	Exists
KIT-7	Water heating heat pump.	X			KIT-7
KIT-8	Eliminate microwave reheating in wards.		X		See text
MISC-1	Install incinerator heat recovery system.	X w/BLR-7			Conditional

NUMBER	DESCRIPTION	FEASIBLE	NOT FEAS	N/A	IMPLEMENTATION
MISC-2	Install computerized energy monitoring and control system.	X			EMCS
USAREUR-1	Zone existing multiple use facilities to reduce energy consumption in minimal use areas.			X	See text
USAREUR-2	Reschedule utilization of existing facilities.			X	See text
USAREUR-3	Consolidate services into permanent buildings through alteration or new construction.			X	See text
USAREUR-4	Connect to District Heating in order to purchase (or sell) energy.		X		Negative SIR
USAREUR - 5 and 6	Interconnect existing power plants. Consolidate existing power plants where forecastable non-recurring maintenance costs can be demonstrated.	X			USAREUR-6
USAREUR-7	Convert to more energy efficient fuels.	X			USAREUR-6
USAREUR-8	Improve existing power plant efficiency through the installation of flue gas dampers, turbulators in fire tube boilers, and oxygen trim control.			X	See text
USAREUR-9	Convert existing energy distribution systems to utilize more efficient medium.			X	OK as is
USAREUR-10	Recover heat from processes such as:				
	- Boiler blowdown heat recovery			X	
	- Refrigerant gas heat recovery	X			HVAC-32
	- Condenser water heat recovery	X			HVAC-34
	- Laundry heat recovery			X	No laundry
	- Mess hall heat recovery		X		KIT-5

NUMBER	DESCRIPTION	FEASIBLE	NOT FEAS	N/A	IMPLEMENTATION
USAREUR-11	Curtail availability of energy to domestic water heaters.			X	PL-1C
USAREUR-12	Insulate existing domestic hot water tanks.			X	Insulated
USAREUR-13	Control light levels automatically.			X	See L-1
USAREUR-14	Utilize photo cell switches.			X	See L-1
USAREUR-15	Utilize high efficiency ballasts.			X	No ballasts
USAREUR-16	Employ spot heating in lieu of existing unit heaters.			X	No unit heaters
USAREUR-17	Provide or improve existing controls such as:				
	- Thermostatic radiator valves			X	HVAC-22
	- Night setback controls	X			HVAC-26,MISC-2
	- Cycle fans and pumps			X	HVAC-9,HVAC-1
	- Use outside air for free cooling	X			HVAC-17, MISC-2
USAREUR-18	Insulate basement ceilings,			X	Bsmts Heated
	walls		X		BLDG-7
	attic floors	X			BLDG-3
	roofs			X	Ventilated
USAREUR-19	Install storm or energy efficient windows,		X		See BLDG-2
	reduce window area		X		MILCOM EEAP
	install translucent panels			X	See text for
	upgrade by replacement			X	4 items
	install thermal barriers			X	
	modify skylights			X	
USAREUR-20	Replace existing doors,			X	See text
	and air curtains.			X	See text

E.1.4.2 RECOMMENDED ECO'S:

Table ES-5 lists the recommended ECO's.

Three types of projects have been provided. From AR5-4, Change 1, Productivity Capital Investment Program (PCIP), two types have been developed: QRIP and OSD PIF. The "rules" for projects in these categories are:

- Quick Return on Investment Program (QRIP) covers projects with a cost less than $100,000 and amortization of less than 2 years.

- OSD Productivity Investment Funding (OSD PIF) covers projects with costs greater than $100,000 and amortization of less than 4 years.

The balance of projects, where amortization was greater than 4 years, but with SIR's of 1.0 or greater, have been provided as Facility Engineering Work Requests.

Project documentation packages are included in Section 10, Volume I.

E.1.4.3 ECIP PROJECTS DEVELOPED:

No ECIP Projects were developed.

The EMCS project cost exceeded $200,000, but the amortization period of 2.1 years allows it to be proposed as are OSD PIF project.

BLDG-7, Exterior Insulation, would have required an ECIP project due to a cost in excess of $200,000 and an SIR greater than 1.0 when analyzed by hand calculations and the degree-day method. However, exterior insulation was not "proven" to save energy by BLAST simulation. The time lag of heavy masonry walls and interior mass negates insulation effectiveness.

TABLE ES - 5
RECOMMENDED ECO'S

ECO NUMBER	DESCRIPTION	PROJECT REFERENCE
MISC-2	Install computerized energy monitoring and control system. Included within or controlled by EMCS are: HVAC-1: Shut off air handling units. Include freeze protection. HVAC-2: Reduce outside air intake. HVAC-17: Use outside air for free cooling. HVAC-14: Reset hot and cold deck temperatures. HVAC-18: Reduce reheating of cooled air. HVAC-25: Eliminate simultaneous heating and cooling. HVAC-26: Install night setback controls. HVAC-29 Repair HVAC controls. ELEC-1: Shut off elevator MG sets, nights & weekends. USAREUR-17: Reset hot water circulation temperature based on outside temperature. PL-1A & C: DHW recirculation timer and point of use heaters, new building. PL-1B: DHW recirculation, old building	OSD PIF
MISC-1	Install incinerator heat recovery system, conditional, and applications: BLR-7: Install air preheater, gas boilers.	QRIP
HVAC-35	Repair HVAC System, Theatre.	Work Order
HVAC-36	Repair HVAC System, Chapel.	Work Order
HVAC-10	Convert 3-way valves to 2-way.	QRIP
HVAC-19	AHU-3 Run-Around Coils	Work Order
HVAC-33	Install tube cleaning brushes in chillers.	Work Order
HVAC-34	Recover waste heat from chiller condensers.	Work Order
BLR-3	Preheat combustion air, oil-fired boilers.	QRIP
BLR-6	Install economizers, gas boilers.	QRIP

ECO NUMBER	DESCRIPTION	PROJECT REFERENCE
L-1	Install photocell controls for office lighting.	Rejected by USAHN
BLDG-3	Install attic floor insulation and heat tapes in Part J.	Work Order
ELEC-8	Install energy efficient electric motors.	N/A. Maint. Instr.
PL-3	Install shower flow restrictors.	QRIP
KIT-7	Recover waste heat from dish and pot washing and amplify temperature with heat pump.	Work Order
USAREUR-5, 6 & 7	Consolidate heating plant operations.	Work Order

E.1.5 ENERGY AND COST SAVINGS

E.1.5.1 TOTAL POTENTIAL ENERGY SAVINGS:

The total potential annual energy savings which could result from the ECO's and projects summarized in the previous paragraph are:

TYPE ENERGY	MBTU'S/YEAR		
	CONDITIONAL	NON-EMCS	EMCS & ASSOC.
Electricity, site	-	380.2	905.1
Anthracite Coal	-	1,763.5	1,364.1
Natural Gas	3,638.1	41.1	17,387.8
No. 2 Oil	-	800.	
Total	3,638.1	2,984.8	19,657.0

The "Conditional" savings would be from Incinerator Heat Recovery and its applications which have been specified by the DEH as conditional to continued use of the Incinerator in Building 477. The decision concerning retention of the existing incinerator, or its renovation/replacement, is to be made on or before April 1987.

E.1.5.2 PERCENT OF ENERGY CONSERVED:

The average total energy consumed at the USAHN over FY's 83-85 is 83,144 MBTU. The minimum projected savings of 2,984.8 plus 19,657 (= 22,641.8) MBTU is equivalent to 26% of the pre-conservation energy consumption.

If the conditional incinerator ECO's become acceptable, savings increase to 25,479.9 MBTU and percent saved to 30%.

The breakout of pre- and post-conservation percentages by fuel is shown on Table ES-6.

TABLE ES – 6
PERCENTAGE OF ENERGY CONSERVED

TYPE ENERGY	FY 83-85 AVERAGE ANNUAL, MBTU'S	SAVINGS, CONDIT'L, MBTU'S	% COND'L	SAVINGS, NON-EMCS, MBTU'S	% NON-EMCS	EMCS & ASSOC.	% EMCS	TOT. MBTU, NON-COND'L
ELECTRICITY, STTE	16,983	–	N/A	380.2	2.	905.1	5.3	1,285.3
ANTHRACTTE COAL	26,468	–	N/A	1,763.5	7	1,364.1	5.1	3,127.6
NATURAL GAS	25,464	3,638	14	41.1	0.2	17,387.8	68.3	17,428.9
NO. 2 OIL	14,228	–	N/A	800	6	–		800
TOTALS	83,143	3,638	4	2,984.8	3.6	19,657	23.6	22,641.8

E.1.5.3 BEFORE/AFTER ENERGY USE AND COST:

Pricing of energy in the following scenarios is from CY 1985 and sources noted:

ENERGY	$ /MBTU	SOURCE
Electricity, site	14.07	DEH, N-berg DM 42.22/3.0
Anthracite Coal	5.26	VII Corps
Natural Gas	5.57	DEH, N-berg DM 16.72/3.0
No. 2 Oil	6.32	VII Corps

The average FY 82-85 year's energy cost is:

ENERGY	AVG MBTU (Table ES-6)		ANNUAL COST, $
Electricity	16,983		238,951
Coal	26,468		139,222
Gas	25,464		141,834
Oil	14,228		89,921
	83,143	Total	$609,928

After implementation of all but the Conditional (Incinerator-related) ECO's, annual energy cost will be:

	MBTU		ANNUAL COST, $
Electricity	15,698		220,871
Coal	23,340		122,768
Gas	8,035		44,755
Oil	13,428		84,865
	60,501	Total	$473,259

The percent reduction is 22% of FY85 cost. The percent reduction in energy is 27% of the 3-year average.

If the conditional ECO's are added, annual energy cost will be:

	MBTU		ANNUAL COST $
Electricity	15,698		220,871
Coal	23,340		122,768
Gas	4,397		24,491
Oil	13,428		84,865
	57,133	Total	$452,995

The change in cost, from FY85 will be 25.7% and the energy change would be 31%.

E.1.6 ENERGY PLAN

E.1.6.1 PROJECT BREAKOUTS:

Table ES-7 lists all recommended ECO'S with total costs and SIR's. They are in sequence from high to low SIR. Where funding constraints occur, priority should be given to implementation of projects with numerically higher SIR's.

Energy savings have been developed by analyses where synergistic interrelationships between ECO's have been considered. Savings calculations have been made by manual calculations to assess benefits from individual ECO's. BLAST program simulation of groups of ECO's was also performed to correlate ECO group savings with the sum of individual ECO's savings. No synergistic anomolies were discovered.

E.1.6.2 PROJECT SCHEDULES:

Figure ES-1, Implementation Schedule, provides simplified schedules for implementation of ECO's. Construction schedules have been proposed for minimum disruption of operations.

Consolidation of Heat Plant Operations is a no cost action and should be implemented first.

Since major savings and operational advantages will result from installation of the Energy Monitoring and Control System, it should be installed as soon as practicable.

Thereafter, all projects may be implemented on the basis of SIR rank. Heat recovery from the Incinerator and use of that heat is conditional to retention of the Incinerator.

TABLE ES-7

RECOMMENDED PROJECTS

ALL SIR ANALYSES DONE IN NOVEMBER 1986

ECO REF. NO.	NAME	IMPLEMENT'N (1) COST, $	SAVINGS, MBTU ELECTR.	SAVINGS, MBTU HEAT	AMORT., YRS.	SIR	ENERGY SAVINGS, $/YEAR
USAREUR-5 & 6	Consolidate Heat Plant Operations	-0-	-	3,266.3	N/A	N/A	7,237(2)
PL-3	Shower Flow Restrictors	541	-	261.3	0.4	37.0	1,375
BLR-6	Economizer, Gas	6,473	-	1,758.4	0.6	26.6	9,794
MISC-1 & BLR-7	Incinerator H.R. & Applications	20,798	-	3,638.0	1.3	12.1	14,276
BLR-3	Economizer, Oil	7,754	-	800.0	1.4	11.5	5,056
MISC-2	Install EMCS	270,000	905.1	18,751.9	2.1	5.0	116,751
HVAC-10	Convert 3-Way Valves to 2-Way	402	13.3	-	2.0	4.4	186
KIT-7	Heat Recovery W/ Heat Pump	10,289	<47>	343	7.4	2.5	1,250
HVAC-19	AHU-3 Run-Around	23,872	-	818.5	5.0	2.0	4,305
BLDG-3	Insulate Attic Floor, Part J	46,816	-	1,145.7	7.0	1.9	6,027

PROJECT REF. NO.	NAME	IMPLEMENT'N COST, $	SAVINGS, MBTU		AMORT., YRS.	SIR	ENERGY SAVINGS, $/YEAR
			ELECTR.	HEAT			
HVAC-34	Condenser Heat Recovery	3,551	-	104.0	5.5	1.9	579
PL-1B	Recirc. DHW , "Old" Building	6,606	1.1	125.9	8.8	1.5	678
HVAC-35	Repair Theatre HVAC	23,927	-	596.3	6.9	1.4	3,136
HVAC-33	Chiller Brushes	9,084	78.7	-	7.4	1.2	1,107
PL-1 A & C	Recirc. DHW, "New" Building	4,384	5.5	41.8	8.1	1.2	310
HVAC-36	Repair Chapel HVAC	19,940	-	393.5	8.1	1.1	2,070

(1) Implementation Cost is sum of Construction, Contingency, and SIOH.
(2) Does not include Operation and Maintenance savings of $142,448 per year.

FIGURE ES-1

IMPLEMENTATION SCHEDULE

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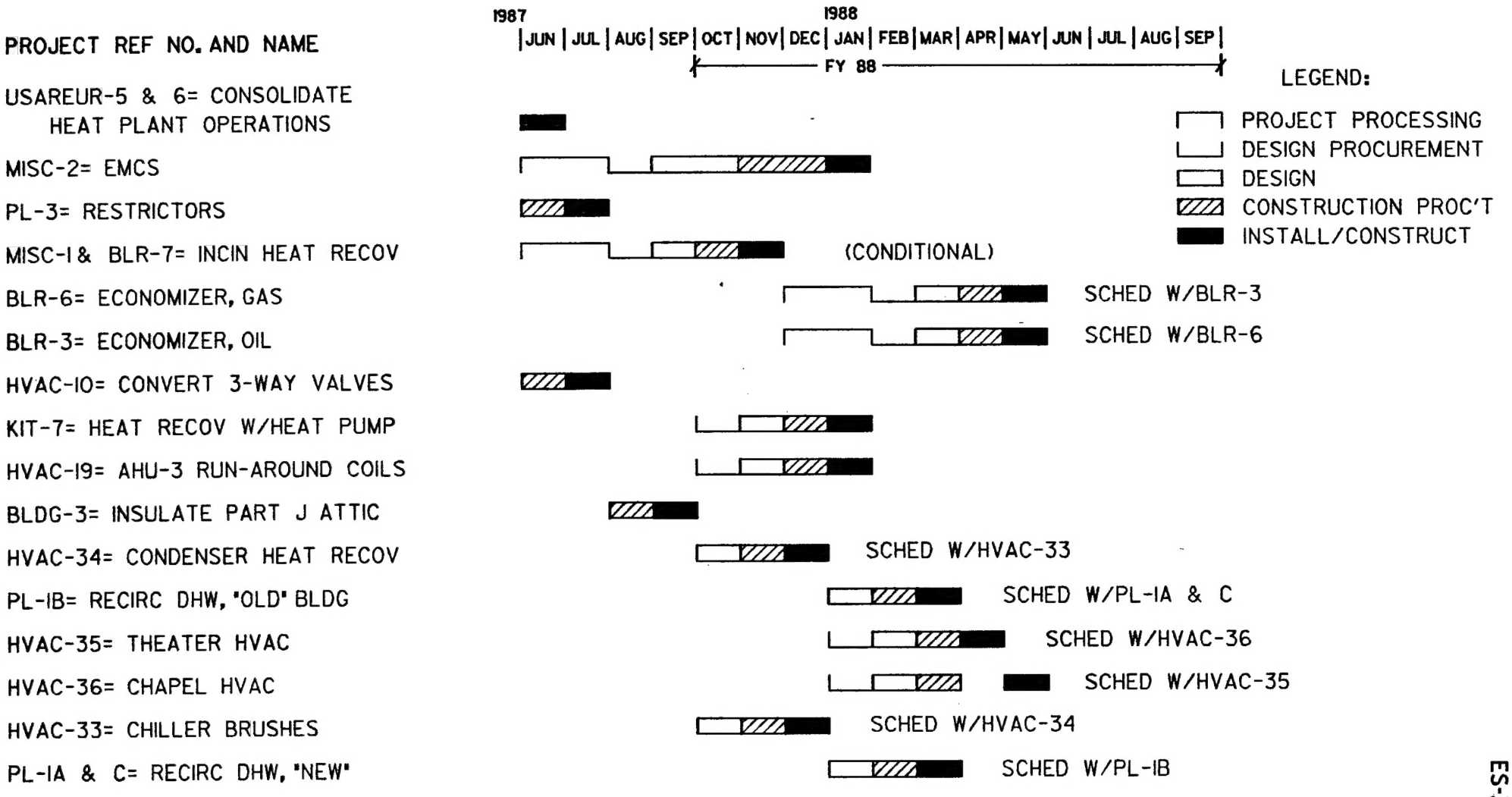

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